Hawaii Medical Professionals Assessment

A study of the availability of doctors and nurses to staff non-hospital, field medical facilities for mass casualty incidents resulting from the use of *weapons of mass destruction* and the level of knowledge and skills of these medical professionals as related to the treatment of victims of such incidents.

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Study objective

The purpose of this study was to determine the capacity of Honolulu to provide emergency medical care to victims of an incident caused by a Weapons of Mass Destruction (WMD) or natural disaster and to determine the level of expertise of the healthcare professionals in the community.

Introduction

Honolulu began planning a response to a mass casualty incident due to a man made or natural disaster in 1997 as part of the Metropolitan Medical Response System (MMRS) promoted and supported by the Department of Health and Human Services (DHHS). The MMRS cities were asked by DHHS to be able to provide medical care for victims of a biological incident up to 10 percent and fatalities up to 2.5 percent of their population, or in Honolulu's case, approximately 100,000 patients and 25,000 fatalities. With a total of 1,330 beds in 12 hospital facilities in Honolulu, and with fewer than 230 beds available to new patients on a given day, the Honolulu MMRS Planning and Development (MMRS P&D) Committee realized the need to establish alternative medical facilities, such as non-hospital, field medical facilities to provide the medical care, as hospital resources would be quickly overwhelmed. However, while exploring possible response systems the Committee also realized that even if it could establish and supply alternative medical care facilities to treat victims of a weapon of mass destruction incident, Honolulu might have difficulty in staffing such facilities. In addition, the MMRS P&D Committee thought that doctors and nurses volunteering in such facilities might not be knowledgeable and skilled in treating victims of weapons of mass destruction (WMD).

Consequently, this study sought to determine both the capacity of Honolulu to staff medical field facilities and the level of knowledge and skills, as related to biological and chemical weapons of mass destruction, of those available to staff such facilities.

Methods

Study

The Hawaii Medical Professionals Assessment, a four page 16-question assessment tool, was mailed to the target audience on July 11, 2001, and a return date of July 31, 2001 was set, although responses were accepted until August 15, 2001, due to late submission by those on vacation. The target audience included physicians, doctors of osteopathy, advanced practice registered nurse, registered nurses, and licensed practical/vocational nurses. "Physicians" included all active, licensed practitioners, retired licensed practitioners, doctors of osteopathy, and medical residents (n=2,235) living in Hawaii. "Nurses" included all advanced practice registered nurses, registered nurses, and licensed vocational/practical nurses (n= 12,380) living in Hawaii.

Procedure

The MMRS P&D Committee assisted the authors in the development of the assessment tool. This collaborative effort included representatives from the Hawaii State Department of Health, the Hawaii Healthcare Association, the University of Hawaii School of Medicine, The Queen's Medical Center, the Hawaii Nurses Association, Tripler Army Medical Center and the National Disaster Medical System, the Hawaii State and Oahu Civil Defense Agencies, and the Honolulu Emergency Services Department.

The Hawaii Medical Association, a private group that maintains a databank based upon state licensing, regardless of membership, supplied the names and addresses of physicians. The Hawaii Nurses Association also maintains a databank based upon state licensure, and supplied most names and addresses of nurses.

The Assessment Tool

The assessment tool, the Hawaii Medical Professionals Assessment, was comprised of sixteen questions dealing with a variety of issues, e.g., knowledge and ability as related to biological agents and categories of chemical agents, interest in training and education, areas of professional expertise, how best to utilize professional skills during a mass casualty incident, the effect various conditions might have on an individual's willingness to staff emergency field medical facilities and, ultimately, whether the individual would help staff a non-hospital, field medical facilities during a mass casualty event. This paper focuses on responses to the questions about knowledge and ability, interest in receiving more education and training, and commitment to staff non-hospital, field medical facilities.

The first six questions dealt with the issues relating to general

knowledge of, ability to recognize signs and symptoms of, and ability to treat specific biological agents and groups of chemical agents. These included anthrax, brucellosis, plague, small pox, tularemia, hemorrhagic fever, influenza, E. coli, and salmonella, for Questions 1 to 3, and nerve agents, choking agents, blood and blistering agents for Questions 4 to 6. Question 7 asked participants to indicate whether they had an interest in receiving additional training concerning the agents listed above.

Assessment Tool Distribution

Before the onset of the study, three field tests were conducted with different groups of doctors and nurses who were part of the target audience. The first field test was conducted at a meeting of the State Department of Health, Morbidity and Mortality Committee consisting of twelve emergency care professionals, i.e., eight emergency room physicians, two "other" physicians, one registered nurse, retired, with active license, and one unmarked professional. The second field test, using an updated version, was conducted at a Hawaii Nurses Association meeting. The survey was given to seven registered nurses. In the third field test thirteen public health nurses completed a revised assessment tool and further feedback was received. In each field test, minimal explanation was given prior to the handing out of the tool. A cover letter was attached to each. The attempt was to approximate the same situation as if the assessment tool and cover letter had arrived in the mail. The participants in these three field tests had no prior knowledge of the project. Comments, questions, and suggestions from these meetings were evaluated and changes were incorporated into the final version of both the introduction letter and the assessment tool.

Analysis

All analyses were conducted separately for doctors and nurses. The response frequencies for each of the 16 questions were calculated. In addition to these univariate analyses, other analyses examined possible interactions between the respondents' level of knowledge, ability to recognize and ability to treat the various agents, and their willingness to receive more training and education, as well as their willingness to staff non-hospital field medical facilities. Summary scores were used to characterize respondents' level of knowledge, and ability to recognize and treat. The biological summary score was the arithmetic sum of responses to questions on the nine biologic agents. A value of 1 was assigned to an "Agree" response, 2 for "Somewhat agree", 3 for "Somewhat disagree", and 4 for "Disagree". (The treatment of missing responses is discussed in the paragraph below.) Similarly, a chemical score summary was the sum of responses to questions on the four chemical agent groups. These two summary scores were then divided into either quartiles or tertiles with roughly equal numbers of respondents, after distinguishing respondents who answered "disagree" to all the selections concerning either the biological or chemical agents. (This included 11.6% of the biological scores and 51.6% of the chemical scores of the combined group of doctors and nurses, i.e. 3,334). Consequently, although the numbers of healthcare professionals in the individual quartile and tertile categories were not equal, these terms were used for the sake of convenience. Quartiles were used for the biological scores, and tertiles for the chemical scores.

The fourth quartile for physician biological score was determined by the number of physicians (n = 99) reporting the least knowledge and ability as defined by their knowledge of, ability to recognize signs and symptoms of, and ability to treat biological agents. The fourth quartile for nurse biological score was determined by the number of nurses (n = 289) reporting the least knowledge and ability as defined by their knowledge of, ability to recognize signs and symptoms of, and ability to treat biological agents. The third tertile for the physician chemical score was determined by the number of physicians (n = 283) reporting the least knowledge and ability as defined by their knowledge of, ability to recognize signs and symptoms of, and ability to treat chemical agents. The Third Tertile for nurse chemical score was determined by the number of nurses (n = 1438) reporting the least knowledge and ability as defined by their knowledge of, ability to recognize signs and symptoms of, and ability to treat chemical agents.

Surveys from 60 (11% of 559) of the physicians and 425 (15% of 2775) of the nurses had missing responses to at least one of the 39 options for the six questions. In general, approximately one-third (186) of these 485 assessments tools were missing responses to only one option, while one-half (239) were missing responses to three or fewer options. Rather than discard the responses of these participants from analyses when computing the biological and chemical scores, missing responses were given a value equal to a "Disagree" response. Although it is not possible to verify this assumption, results from analyses in which the missing responses were valued the same as an "agree" response were very similar to the results presented here, i.e., assigning a missing response the value of "agree" or "disagree" did not change the participant's quartile. Assigning missing responses the same value as a "disagree" response produces a conservative bias, if any, in the characterization of the knowledge and ability of the respondents."

Results

Survey Participants: Profession and Specialty

A total of 3,386 (23.1%) surveys were returned, with and additional 302 non-deliverables, i.e., 16 doctors and 286 nurses. Respondents included 559 of 2,235 (25%) physicians and 2,775 of 12,380 (22.4%) nurses. Since responses were analyzed according to professional status, i.e., Doctor or Nurse, responses were not utilized from the 52 respondents who did not specify profession.

The most common specialty among doctors was primary care, accounting for 42% of the total. Thirty-two percent of the physician respondents chose the category "Other" for the category specialty; another 8.2% of the physicians were added to the "Other" group, which included a small number of retired physicians (12), infectious disease (8), pulmonary (8), and multiple specialty physicians (18). Thus, 40.2% of the physicians were in the "Other" group. Surgeons comprised 14%, and emergency physicians only 4%. More than two-thirds (69.7%) of the nurses reported RN credentials, and 7% more reported they had advanced practice RN credentials. Most of the rest were Licensed Practical/Vocational Nurses (13%), or Retired (10%).

Knowledge and Ability Concerning Biological Agents

Physicians and Biological Agents

In response to the statement concerning *knowledge* of nine biological agents, i.e., "I am knowledgeable about...," the biological agent

physicians reported knowing the most about was Influenza, receiving 52% of the "agree," or "knowledgeable," responses. The biological agent physicians reported knowing the least about was Tularemia, receiving only 8% of the "agree" or "knowledgeable" responses and 52% of the "disagree" or "not knowledgeable," responses. Physicians' responses to the nine agents are presented in Table 1.

In response to the statement concerning the *ability to recognize the signs and symptoms* of nine biological agents, i.e., "I can recognize the signs and symptoms of...," the biological agent physicians reported being able to most recognize was Influenza, receiving 54% of the "agree," or "able to recognize" responses. The biological agent physicians reported being able to recognize the least was Tularemia, receiving only 5% of the "agree" or "able to recognize" responses, and 56% of the "disagree" or "not able to recognize," responses. Physicians' responses to the nine agents are presented in Table 2.

In response to the statement concerning the *ability to treat* nine biological agents, i.e., "I know how to treat casualties of a biological incident involving...," the biological agent physicians reported most able to treat was Influenza, receiving 42% of the "agree," or "able to treat" responses. The biological agents physicians reported least able to treat were Anthrax and Tularemia, with Tularemia getting only 5% and Anthrax getting 7% of the "agree" or "ability to treat" responses, and both getting 64% of the "disagree" or "not able to treat," responses. Physicians' responses to the nine agents are presented in Table 3.

Nurses and Biological Agents

In response to the statement concerning *knowledge* of nine biological agents, i.e., "I am knowledgeable about...," the biological agent nurses reported knowing the most about was Influenza, receiving 51% of the "agree," or "knowledgeable," responses. The biological agent nurses reported knowing the least about was Tularemia, receiving only 3% of the "agree" or "knowledgeable" responses and 72% of the "disagree" or "not knowledgeable," responses. Nurses' responses to the nine agents are presented in Table 4.

In response to the statement concerning the *ability to recognize* nine biological agents, i.e., "I can recognize the signs and symptoms of exposure to...," the biological agent nurses reported most able to recognize was Influenza, receiving 49% of the "agree," or "able to recognize signs and symptoms" responses. The biological agent nurses reported least able to recognize was Tularemia, receiving 2% of the "agree" or " able to recognize signs and symptoms " responses, and 75% of the "disagree" or "not able to recognize signs and symptoms" responses. Nurses' responses to the nine agents are presented in Table 5.

In response to the statement concerning the *ability to treat* nine biological agents, i.e., "I know how to treat casualties of a biological incident involving..., " the biological agent nurses reported most able to treat was Influenza, receiving 38% of the "agree," or "able to treat" responses. The biological agent nurses reported least able to treat was Tularemia, with only 2% reporting "agree" or "able to treat" and 78% reporting "disagree" or "not able to treat." Nurses' responses to the nine agents are presented in Table 6.

Table 1. — Physicians knowledgeable about Biological Agents*

Bio Agent	Agree	Somewhat Agree	Somewhat Disagree	Disagree
Anthrax	10% (56)	23% (126)	17% (95)	48% (267)
Brucellosis	08% (47)	20% (110)	18% (98)	51% (288)
Plague	11% (63)	19% (105)	19% (108)	48% (267)
Small pox	15% (83)	22% (123)	18% (99)	43% (242)
Tularemia	08% (42)	17% (95)	20% (110)	52% (293)
Hemorrhagic fever	10% (58)	20% (111)	19% (106)	47% (265)
Influenza	52% (292)	19% (107)	06% (34)	21% (117)
E. coli	45% (252)	25% (140)	07% (38)	22% (121)
Salmonella	34% (191)	27% (149)	10% (55)	27% (151)

*Percentages of no responses for each of the nine biological agents were as follows: anthrax, 3% (15); brucellosis, 3% (16); plague, 3% (16); small pox, 2% (12); tularemia, 3% (19); influenza 2% (9); E. coli, 1% (8); salmonella, 2% (13); hemorrhagic fever, 3% (19).

Table 2. — Physicians' ability to recognize signs and symptoms of exposure to Biological Agents*

Bio Agent	Agree	Somewhat Agree	Somewhat Disagree	Disagree
Anthrax	08% (45)	15% (85)	20% (113)	53% (298)
Brucellosis	06% (33)	14% (81)	21% (120)	55% (305)
Plague	07% (41)	18% (98)	20% (114)	52% (288)
Small pox	14% (78)	23% (126)	20% (113)	40% (225)
Tularemia	05% (27)	14% (79)	20% (114)	56% (313)
Hemorrhagic fever	12% (66)	19% (106)	19% (105)	48% (267)
Influenza	54% (303)	19% (107)	05% (29)	20% (111
E. coli	43% (241)	25% (141)	08% (45)	21% (119)
Salmonella	35% (195)	25% (141)	10% (58)	27% (152)

*Percentages of no responses for each of the nine biological agents were as follows: anthrax, 3% (18); brucellosis, 4% (20); plague, 3% (18); small pox, 3% (17); tularemia, 5% (26); influenza, 2% (9); E. coli, 2% (13); salmonella, 2% (13); hemorrhagic fever, 3% (15).

Table 3. — Physicians' ability to treat casualties of a Biological Incident*

Bio Agent	Agree	Somewhat Agree	Somewhat Disagree	Disagree
Anthrax	07% (38)	12% (68)	15% (82)	64% (355)
Brucellosis	06% (31)	11% (63)	17% (97)	62% (349)
Plague	06% (35)	13% (75)	16% (89)	61% (343)
Small pox	09% (53)	10% (58)	17% (94)	60% (338)
Tularemia	05% (26)	10% (55)	18% (100)	64% (356)
Hemorrhagic fever	08% (42)	13% (75)	17% (97)	58% (325)
Influenza	42% (232)	20% (111)	08% (43)	28% (159)
E. coli	36% (204)	22% (125)	09% (51)	30% (167)
Salmonella	31% (176)	21% (119)	09% (53)	35% (197)

*Percentages of no responses for each of the nine biological agents were as follows: anthrax,3% (16); brucellosis, 3% (19); plague, 3% (17); small pox, 3% (16); tularemia, 4% (22); influenza, 3% (14); E. coli, 2% (12); salmonella, 3% (14); hemorrhagic fever, 4% (20).

Table 4. — Nurses knowledgeable about Biological Agents*

Bio Agent	Agree	Somewhat Agree	Somewhat Disagree	Disagree
Anthrax	09% (238)	18% (498)	17% (478)	52% (1443)
Brucellosis	04% (98)	09% (257)	14% (399)	68% (1881)
Plague	10% (276)	18% (512)	19% (518)	48% (1337)
Small pox	19% (520)	24% (667)	17% (482)	37% (1014)
Tularemia	03% (78)	06% (179)	12% (335)	72% (2004)
Hemorrhagic fever	11% (296)	18% (500)	19% (535)	48% (1321)
Influenza	51% (1407)	27% (747)	07% (206)	13% (369)
E. coli	43% (1194)	31% (854)	09% (257)	15% (418)
Salmonella	32% (875)	29% (817)	12% (342)	24% (666)

*Percentages of no responses for each of the nine biological agents were as follows: anthrax, 4% (118); brucellosis, 5% (140); plague 5% (132); small pox 3% (92); tularemia, 6% (179); influenza, 2% (46); E. coli, 2% (52); salmonella, 3% (75); hemorrhagic fever, 4% (123).

Table 5. — Nurses' ability to recognize signs and symptoms of exposure to Biological Agents*

Bio Agent	Agree	Somewhat Agree	Somewhat Disagree	Disagree
Anthrax	05% (132)	10% (290)	15% (429)	64% (1785)
Brucellosis	03% (70)	06% (154)	13% (368)	73% (2033)
Plague	06% (157)	12% (342)	18% (499)	59% (1629)
Small pox	15% (416)	21% (585)	17% (483)	43% (1189)
Tularemia	02% (55)	05% (130)	11% (318)	75% (2080)
Hemorrhagic fever	10% (268)	15% (416)	18% (509)	52% (1452)
Influenza	49% (1352)	26% (726)	08% (231)	15% (414)
E. coli	36% (990)	31% (873)	12% (334)	19% (525)
Salmonella	27% (754)	28% (769)	14% (386)	28% (782)

*Percentages of no responses for each of the nine biological agents were as follows: anthrax, 5% (139); brucellosis, 5% (150); plague, 5% (148); small pox, 4% (102); tularemia, 7% (192); influenza, 2% (52); E. coli, 2% (53); salmonella, 3% (84); hemorrhagic fever, 5% (130).

Table 6. — Nurses' ability to treat casualties of a Biological Incident*

Bio Agent	Agree	Somewhat Agree	Somewhat Disagree	Disagree
Anthrax	04% (105)	07% (203)	12% (332)	72% (1998)
Brucellosis	02% (46)	05% (129)	12% (320)	77% (2133)
Plague	04% (107)	09% (241)	15% (409)	68% (1876)
Small pox	09% (262)	14% (395)	15% (407)	58% (1597)
Tularemia	02% (51)	04% (113)	10% (282)	78% (2171)
Hemorrhagic fever	07% (184)	12% (320)	14% (400)	63% (1743)
Influenza	38% (1045)	26% (708)	10% (267)	25% (694)
E. coli	27% (759)	28% (774)	12% (342)	30% (827)
Salmonella	20% (560)	24% (663)	14% (378)	39% (1077)

*Percentages of no responses for each of the nine biological agents were as follows: anthrax, 5% (137); brucellosis, 5% (147); plague 5% (142); small pox, 4% (114); tularemia, 6% (158); influenza, 2% (61); E. coli, 3% (73); salmonella, 4% (97); hemorrhagic fever, 5% (128).

Knowledge and Ability Concerning Chemical Agents

Physicians and Chemical Agents

In response to the statement concerning *knowledge* of four categories of chemical agents, i.e., "I am knowledgeable about...," the chemical agent group physicians reported knowing the most about was Nerve Agents, receiving only 7% of the "agree," or "knowledgeable," responses. The chemical agent physicians reported knowing the least about was Choking Agents, receiving 65% of the "disagree" or "not knowledgeable," responses. Physicians' responses to the four chemical agent groups are presented in Table 7.

In response to the statement concerning the *ability to recognize the signs and symptoms* of four chemical agent groups, i.e., "I can recognize the signs and symptoms of exposure to ....," the chemical agent group physicians reported being able to most recognize was Nerve Agents, receiving 8% of the "agree," or "able to recognize" responses. The chemical agent group physicians reported being able to recognize the least was Blood Agents, receiving 62% of the "disagree" or "not able to recognize," responses. Physicians' responses to the four chemical agent groups are presented in Table 8.

In response to the statement concerning the *ability to treat* four chemical agent groups, i.e., "I know how to treat casualties of a chemical incident involving...," physicians reported Nerve Agents as the group they were most able to treat, i.e., 6% of the "agree," or "able to treat" responses. The chemical agent groups physicians reported least able to treat were Choking Agents and Blood Agents, both getting 68% of the "disagree" or "not able to treat," responses. Physicians' responses to the four chemical agent groups are presented in Table 9.

Nurses and Chemical Agents

In response to the statement concerning *knowledge* of four categories of chemical agents, i.e., "I am knowledgeable about...," the chemical agent group nurses reported knowing the most about was Blood Agents, receiving 10% of the "agree," or "knowledgeable" responses. The chemical agent group nurses reported knowing the least about were Choking and Blistering Agents, each receiving 66% of the "disagree" or "not knowledgeable," responses. Nurses' responses to the four chemical agent groups are presented in Table 10.

In response to the statement concerning the *ability to recognize the signs and symptoms* of four chemical agent groups, i.e., "I can recognize the signs and symptoms of exposure to ....," the chemical agent groups nurses reported being able to most recognize were Choking and Blood agents, i.e., each receiving 8% of the "agree," or "able to recognize" responses. The chemical agent group nurses reported being able to recognize the least was Nerve agents, receiving 64% of the "disagree" or "not able to recognize," responses. Nurses' responses to the four chemical agent groups are presented in Table 11.

In response to the statement concerning the *ability to treat* four chemical agent groups, i.e., "I know how to treat casualties of a chemical incident involving...," the chemical agent group nurses reported most able to treat was Choking Agents, receiving 7% of the "agree," or "able to treat" responses. The chemical agent group nurses reported least able to treat was Nerve Agents, receiving 71% of the "disagree" or "not able to treat," responses. Nurses' responses to the four chemical agent groups are presented in Table 12.

Table 7. — Physicians Knowledgeable about Chemical Agent Groups*

Chemical Agent	Agree	Somewhat Agree	Somewhat Disagree	Disagree
Nerve Agents	7% (41)	15% (83)	18% (98)	58% (326)
Choking Agents	5% (27)	10% (58)	18% (99)	65% (366)
Blood Agents	5% (29)	11% (61)	19% (107)	63% (351)
Blistering Agents	4% (24)	12% (67)	18% (100)	64% (357)

*Percentages of no responses for each of the four chemical agent groups were as follows: nerve agents, 2% (11); choking agents, 2% (9); blood agents, 2% (11); blistering agents, 2% (11).

Table 8. — Physicians' ability to recognize the signs and symptoms of exposure to chemical Agent Groups*

Chemical Agent	Agree	Somewhat Agree	Somewhat Disagree	Disagree
Nerve Agents	8% (43)	18% (99)	16% (87)	57% (318)
Choking Agents	6% (34)	12% (69)	19% (105)	61% (341)
Blood Agents	4% (24)	13% (71)	19% (104)	62% (348)
Blistering Agents	6% (32)	16% (89)	17% (94)	60% (333)

*Percentages of no responses for each of the four chemical agent groups were as follows: nerve agents, 2% (12); choking agents, 2% (10); blood agents, 2% (12); blistering agents, 2% (11).

Table 9. — Physicians' ability to treat casualties of Chemical Agent Groups*

Chemical Agent	Agree	Somewhat Agree	Somewhat Disagree	Disagree
Nerve Agents	6% (31)	12% (66)	15% (83)	65% (364)
Choking Agents	4% (25)	08% (46)	17% (93)	68% (382)
Blood Agents	3% (17)	10% (56)	16% (89)	68% (382)
Blistering Agents	4% (20)	10% (56)	16% (92)	67% (376)

*Percentages of no responses for each of the four chemical agent groups were as follows: nerve agents, 3% (15); choking agents, 2% (13); blood agents, 3% (15); blistering agents, 3% (15).

Table 10. — Nurses knowledgeable about Chemical Agent Groups*

Chemical Agent	Agree	Somewhat Agree	Somewhat Disagree	Disagree
Nerve Agents	05% (141)	13% (352)	14% (382)	65% (1816)
Choking Agents	07% (205)	11% (300)	13% (357)	66% (1837)
Blood Agents	10% (274)	14% (397)	12% (337)	61% (1700)
Blistering Agents	06% (161)	12% (337)	13% (369)	66% (1838)

*Percentages of no responses for each of the four chemical agent groups were as follows: nerve agents, 3% (84); choking agents, 3% (76); blood agents, 2% (67); blistering agents, 3% (70).

Table 11. — Nurses' ability to recognize the signs and symptoms of exposure to Chemical Agent Groups*

Chemical Agent	Agree	Somewhat Agree	Somewhat Disagree	Disagree
Nerve Agents	5% (142)	13% (355)	15% (414)	64% (1783)
Choking Agents	8% (223)	13% (360)	14% (384)	62% (1734)
Blood Agents	8% (220)	14% (379)	14% (380)	62% (1725)
Blistering Agents	7% (196)	12% (345)	15% (411)	63% (1748)

*Percentages of no responses for each of the four chemical agent groups were as follows: nerve agents, 3% (81); choking agents, 3% (74); blood agents, 3% (71); blistering agents, 3% (75).

Table 12. — Nurses' ability to treat casualties of Chemical Agent Groups*

Chemical Agent	Agree	Somewhat Agree	Somewhat Disagree	Disagree
Nerve Agents	4% (99)	08% (222)	14% (378)	71% (1967)
Choking Agents	7% (184)	09% (255)	13% (359)	68% (1877)
Blood Agents	6% (171)	10% (288)	13% (374)	66% (1842)
Blistering Agents	5% (147)	10% (275)	13% (367)	68% (1881)

*Percentages of no responses for each of the four chemical agent groups were as follows: nerve agents, 4% (109); choking agents, 4% (100); blood agents, 4% (100); blistering agents, 4% (105).

Interest in Training/Education

Respondents were asked to report whether or not they were interested in receiving more training/education concerning biological and chemical agents. A higher percentage of the nurses were interested in more training and education than were the doctors for both biological, i.e., doctors 73% nurses 85%, and chemical agents, i.e., doctors 72%, nurses 84%. In addition, 75% of the physicians and 74% of the nurses preferred receiving CE credits for education and training.

Commitment to Help Staff Non-Hospital, Field Medical Facilities

Respondents were asked to state whether or not they would help staff a field medical facility under the conditions of different types of incidents, i.e., Biological, Chemical, Explosion, Radiological, Contagious Epidemic, and Natural Disaster. The results of this study showed that during a Natural Disaster a large majority of the respondents, 83% of doctors and 90% of nurses, would help staff non-hospital, field medical facilities. However, far fewer respondents, 52% of doctors and 45% of nurses, said they would help staff these same facilities if a Radiological Incident caused mass casualties. The responses of physicians and nurses who stated they "would help staff" are shown in Table 13. Note that both groups differentiated between the types of events in terms of their availability in the same order, i.e. from most available to least available.

Table 13. — Commitment to help staff non-hospital, field medical facilities by Incident and Profession*

	Physician*	Nurse*
Natural Disaster	83% (461)	90% (2499)
Explosion Incident	67% (372)	70% (1941)
Chemical Incident	59% (329)	59% (1644)
Biological Incident	56% (315)	53% (1474)
Contagious Epidemic	56% (312)	49% (1352)
Radiological Incident	52% (290)	45% (1254)

* number of physicians, n = 559 and nurses, n = 2775 responding

Commitment to Help Staff Non-Hospital, Field Medical Facilities in Relation to Biological and Chemical Scores

A comparison was made to determine if there was a relationship between the level of knowledge and ability of the physicians and nurses, as reflected in their biological and chemical scores, and their commitment to help staff non-hospital, field medical facilities. In this analysis items such as Explosion Incident, Radiological Incident, and Natural Disaster were eliminated, as responses to these types of events would have no evident relationship to knowledge and ability concerning biological and chemical agents. The biological quartiles and the chemical tertiles described earlier were used in this analysis.

Physician

Physician *Biological Scores*, the sum of reported knowledge and ability related to biological agents, and responses to whether or not they would help staff non-hospital, field medical facilities in the event of a *Biological Incident* were compared. Results of this analysis are listed in Table 14 and indicate that the more knowledge and ability physicians reported, the more willing they were to help staff non-hospital, field medical facilities during a biological incident. For example, 74.7% of doctors categorized as "most knowledgeable and able" stated they would help. Whereas, only 35.4% of those in the "least knowledgeable and able" quartile committed to help.

Physician responses to staff field medical facilities during a *Contagious Epidemic* were compared to their *Biological Scores*. Results of this analysis are listed in Table 15 and indicate that the more knowledge and ability physicians reported, the more they stated they would help staff non-hospital, field medical facilities during a contagious epidemic. For example, whereas 75.3% percent of physicians who reported having the most knowledge and ability in reference to biological agents said they would help staff field hospital facilities during a contagious epidemic, only 33.3% of those in the least knowledge and ability quartile committed to do so.

Physician responses to staff field medical facilities during a *Chemical Incident* were compared to *Chemical Scores*. Results of this analysis are listed in Table 16 and indicate that the more knowledgeable and able physicians reported being with a chemical agents the more they stated they would help staff non-hospital, field medical facilities. For example, 78.4% percent of those who reported being most knowledgeable and able in reference to chemical agents committed to help during a chemical incident, in contrast to only 41.7% of those in the least knowledgeable and able tertile.

Nurse

Nurse *Biological Scores*, the sum of reported knowledge and ability related to biological agents, and responses to whether or not they would help staff non-hospital, field medical facilities in the event of a *Biological Incident* where compared. Results of this analysis are listed in Table 17 and indicate that the more knowledge and ability nurses reported, the more they stated they would help staff non-hospital, field medical facilities during a biological incident. For example, whereas 66.2% percent of nurses who reported having the most knowledge and ability in reference to biological agents said they would help staff field hospital facilities during a biological incident, only 41.9% in the third quartile and 42.6% of those in the least knowledge and ability fourth quartile committed to do so.

Nurse responses to whether or not they would staff field medical facilities during a *Contagious Epidemic* were also compared to *Biologic Scores*. Results of this analysis are listed in Table 18 and indicate that the more knowledgeable and able nurses reported in reference to a contagious epidemic the more they stated they would help staff non-hospital, field medical facilities. For example, whereas 60.2% percent of nurses reporting the most knowledge and ability in reference to biological agents said they would help staff field hospital facilities during a contagious epidemic, only 38.1% of those in the least knowledge and ability quartile committed to do so.

Nurse responses to staff field medical facilities during a *Chemical Incident* were compared to their *Chemical Scores*. Results of this

Table 14. — Physician staffing commitment during a Biological Incident compared to Biological Score*

Biological Score Quartile*	Physicians in Quartile	Number in Quartile Would Help Staff	Percentage of Quartile Would Help
1st Quartile	154	115	74.7%
2nd Quartile	181	116	64.1%
3rd Quartile	125	49	39.2%
4th Quartile	99	35	35.4%

*1st Quartile includes most knowledgeable and able, 4th quartile includes not knowledgeable and able.

Table 15. — Physician staffing commitment during a Contagious Epidemic compared to Biologic Score*

Biological Score Quartile*	Physicians in Quartile	Number in Quartile Would Help Staff	Percentage of Quartile Would Help
1st Quartile	154	116	75.3%
2nd Quartile	181	110	60.8%
3rd Quartile	125	53	42.4%
4th Quartile	99	33	33.3%

*1st Quartile includes most knowledgeable and able, 4th quartile includes not knowledgeable and able.

Table 16. — Physician staffing commitment during a Chemical Incident compared to Chemical Score*

Chemical Score Tertile*	Number of Physicians in Tertile	Number in Tertile Would Help Staff	Percentage of Tertile Would Help
1st Tertile	125	98	78.4%
2nd Tertile	151	113	74.8%
3rd Tertile	283	118	41.7%

*1st Tertile includes most knowledgeable and able, 3rd tertile includes not knowledgeable and able.

Table 17. — Nurse staffing commitment during a Biologic Incident compared to Biologic Score*

Biological Score Quartile*	Number Nurses in Quartile	Number in Quartile Would Help Staff	Percentage of Quartile Would Help
1st Quartile	835	553	66.2%
2nd Quartile	865	469	54.2%
3rd Quartile	786	329	41.9%
4th Quartile	289	123	42.6%

*1st Quartile includes most knowledgeable and able, 4th quartile includes not knowledgeable and able.

Table 18. — Nurse staffing commitment during a Contagious Epidemic compared to Biologic Score*

Biological Score Quartile*	Nurses in Quartile	Number in Quartile Would Help Staff	Percentage of Quartile Would Help
1st Quartile	835	503	60.2%
2nd Quartile	865	432	49.9%
3rd Quartile	786	307	39.1%
4th Quartile	289	110	38.1%

*1st Quartile includes most knowledgeable and able, 4th quartile includes not knowledgeable and able.

Table 19. — Nurse staffing commitment during a Chemical Incident compared to Chemical Score*

Chemical Score Tertile*	Nurses in Tertile	Number in Tertile Would Help Staff	Percentage of Tertile Would Help
1st Tertile	745	534	71.7%
2nd Tertile	592	351	59.3%
3rd Tertile	1438	759	52.8%

*1st Tertile includes most knowledgeable and able, 3rd tertile includes not knowledgeable and able.

analysis are listed in Table 19 and indicate that the more knowledge and ability nurses reported, the more they stated they would help staff non-hospital, field medical facilities during a chemical incident. For example, whereas 71.7% percent of nurses who reported having the most knowledge and ability in reference to chemical agents said they would help staff field hospital facilities during a chemical incident, only 52.8% of those in the least knowledge and ability tertile committed to do so.

Commitment to Help Staff Non-Hospital, Field Medical Facilities in Relation to Physicians' Practice

A further analysis was performed by comparing the data concerning "commitment to help staff" to the information respondents provided about their practice or specialty. This was done to determine if practice or specialty made a difference in whether or not they "would help staff" non-hospital, field medical facilities. Due to the low number of respondents representing certain specialties (e.g., infectious disease, pulmonary, etc.), only two categories of doctors were compared. Primary Care physicians comprising 42% (234) of the doctor group were compared to a group labeled "Other," which represented 40.2% (224) of the doctors. The "Other" group included physicians who defined their practice as infectious disease, pulmonary medicine, multiple specialty, and retired with an active license (8.2%), or Other (32%). More of the Primary Care group consistently reported they would help staff field medical facilities than the "Other" group as shown in Table 20. For example, the greatest differences between the two groups were illustrated in their responses to helping staff facilities during a Contagious Epidemic, 68% to 50%, and a Biological Incident, 66% to 51% Primary Care to "Other" respectively.

As 69.7% of the nurses reported RN credentials no analysis was conducted to compare this group to the much smaller nurse groups.

Table 20. — Physician commitment to help staff non-hospital, field medical facilities by Incident and Type of Practice*

	Primary Care*	Other*
Biological Incident	66% (155)	51% (115)
Chemical Incident	67% (157)	54% (122)
Explosion Incident	69% (161)	62% (138)
Radiological Incident	58% (136)	48% (108)
Contagious Epidemic	68% (158)	50% (112)
Natural Disaster	84% (196)	81% (181)

*Primary Care, n= 234; Other, n = 224

Discussion

Staffing Standards, Healthcare Professionals Commitment, and Patient Care Capacity

The purpose of this study was to assess Honolulu's healthcare professional capacity to staff non-hospital, field medical facilities

established to provide medical care to mass casualties caused by a WMD incident or natural disaster, and to determine the level of WMD related knowledge and expertise among these doctors and nurses. The Honolulu Metropolitan Medical Response System (MMRS) Committee sought this information so that emergency planners could calculate the number of patients for whom Honolulu would be able to provide emergency medical care before it would need assistance from Federal sources. In addition, local planners could determine training and education requirements to prepare for a WMD incident and develop materials concerning standing orders and protocols to be used under mass casualty conditions.

To compute the number of doctors and nurses needed to provide care for 10% of Honolulu's population, i.e., 100,000 patients, a MMRS subcommittee utilized the U.S. Army Soldier and Biological Chemical Command (SBCCOM) studies which included staff requirements for non-hospital, field medical facilities. SBCCOM created the Modular Emergency Medical System (MEMS) as an organizational strategy for the care of mass casualties resulting from biological terrorism incidents. For the purposes of this study, staffing needs during mass casualty situations were extrapolated from the SBCCOM standards for two major functions, i.e., the *primary point of entry* into the emergency medical system and *inpatient treatment*. For example, SBCCOM developed the concept of Neighborhood Emergency Help Centers to provide a primary point of entry into the emergency medical system for patients and worried well, in order to distribute prophylactic medications, quickly sort through people seeking care, and ensure that those who need are stabilized for evacuation to a definitive care facility. To accomplish these tasks, SBCCOM suggests the need for a combined staff of 80, including 6 physicians and 18 nurses to cover two 12-hour shifts in order to process and treat 1,000 people a day.[1]

Another SBCCOM emergency medical structure is the Acute Care Center (ACC), which was designed, organized, equipped, and staffed specifically to treat patients who need inpatient treatment but do not require mechanical ventilation and those who are likely to die from illness or injuries. Patients who require advanced life support, such as provided by intensive or critical care units, would receive priority for hospital admission rather than admission to the ACC. If local hospitals were already beyond capacity, the patient(s) would receive as much care as the ACC is capable of providing. SBCCOM defines the inpatient treatment of the ACC as providing only antibiotics, hydration, bronchodilators, and pain management. To provide inpatient treatment to casualties, in general, SBCCOM recommends Acute Care Centers be physically set up into 250-bed pods, each composed of five 50-bed nursing units. The suggested minimum staffing for doctors and nurses, per 12-hour shift for a 50-bed, nursing subunit providing patient care is eight, i.e., one physician and seven nurses.[2] Consequently, staffing an ACC requires 40 doctors and 280 nurses to provide care for 1,000 patients per day during two 12-hour shifts).

Healthcare Professionals Staffing, Type of WMD Incident and Patient Capacity

When estimating the number of healthcare professionals available to provide emergency medical care this study found that it is important to consider the type of weapon of mass destruction used, as participants differentiated between the types of agents for which they would be available to provide care (Table 13). For example, the least number of both doctors and nurses reported they would respond to a Radiological Incident, 52% and 45% respectively, while the most would assist during a Natural Disaster, 83% and 90% respectively. In fact, both doctors and nurses discriminated between the six different types of incidents in relation to their commitment to help in exactly the same manner, i.e., from most to least, Natural Disaster, Explosion, Chemical, Biological, Contagious, and Radiological (Table 13). These findings suggest that emergency planners can not assume that because medical personnel will volunteer to assist in one type of incident, e.g., natural disaster or conventional explosion, that they will do so under conditions involving other weapons of mass destruction, such as biological or radiological. Further studies should identify and explore factors that determine or affect the commitment of healthcare professionals to staff non-hospital, field medical facilities during a mass casualty incident, and how the these factors can be enhanced or mediated, depending on the type of affect on commitment, i.e., negative or positive.

Applying the SBCCOM standard for staffing needs per day described above to the number of doctors who stated they would help staff field medical facilities during a Biological Incident (56%, n = 315), these physicians could provide emergency medical care such as triage, treatment, prophylaxis, and education at primary point of entry facilities to 52,500 victims, or care for approximately 7,900 patients at the inpatient treatment level. In addition, the nurses participating in this study who stated they would help staff field facilities during a Biological Incident (53%, n = 1,474) would be able to provide primary point of entry care to approximately 82,000 victims, or inpatient treatment for 5,264 patients. To estimate a practical capacity for providing emergency care in Honolulu, the percentages of doctors and nurses stating they would help staff field medical facilities for different types of agents were applied, even though the methodology used in this study does not provide a statistically representative sample of the doctors and nurses in Hawaii. Thus, to project availability of healthcare professionals during a biological incident, the factor .56 (Table 13) was applied to the 2,235 total doctors in the state, resulting in 1,252 doctors who might assist in field medical facilities. Utilizing the staffing standards described earlier, estimations show this number of doctors could treat approximately 209,000 (21% of Honolulu's population) victims with primary point of entry care, or 31,300 patients (3% of Honolulu's population) at the inpatient treatment level during a biological incident. Applying similar logic, if 53% (Table 13) or 6,561 of Hawaii's 12,380 nurses were willing to assist in treating patients exposed to biologic agents, Honolulu would be able to provide 364,522 victims (36% of Honolulu's population) with primary point of entry level care or approximately 23,400 patients (2.3% of Honolulu's population) with inpatient treatment. As the projections of staffing and patient capacity imply, Honolulu, and any other city for that matter, has a better opportunity of meeting the requirements of emergency medical care for its population during a WMD-related mass casualty incident if it can provide most or all of that care through primary point of entry level functions rather than at the inpatient treatment level. Relman states, "Intervention during this early preclinical incubation phase provides the greatest opportunity for benefit."[3] Thus, the above capacity estimations highlight the need for not only improvement of the traditional public health

surveillance system that tracks symptoms, syndromes and health indicators, but also implementation of precautionary environmental surveillance and detection systems that allow monitoring of the environment even when there is no direct or known threat so that a biological agent release can be detected and identified before symptoms occur in the population. As suggested by the calculations above, the risks are great and a community may increase the efficiency of its medical and public health staffing resources if it can be in a position to only need to provide prophylactic care for its citizens rather than therapeutic treatment.

Accordingly, soon after September 11, 2001 Honolulu established an environmental surveillance and detection system, the Biological Weapons Illness Prevention Program, or BioWIPP, to monitor water and air for release of biological agents. As a result, air samples have been taken routinely and analyzed at major nationally or internationally recognized events, such as the NFL Pro Bowl, concerts given by well known celebrities such as Janet Jackson, and nationally televised local sports events, e.g., those involving the University of Hawaii, as well as other high visibility events involving mass-gatherings in the city. In addition, as part of this program, Honolulu regularly samples its water and tests with PCR technology for biological agents, and has developed a 24-hour a day air sampling system also using PCR technology for agent detection and identification. The goal of Honolulu's environmental surveillance program is to augment the public health system's clinical surveillance network so that a biological agent can be detected within 24-hours of its release. Such a system allows the public health sector to definitively determine the presence of a biological weapon and affords the possibility to provide prophylactic treatment to those exposed and infected before they become symptomatic and need inpatient treatment or critical care. If this type of precautionary environmental surveillance and detection system is successful, Honolulu would have enough healthcare professionals, as projected above, to care for more than the minimum standard of 10% of the population in a biological incident at its primary point of entry facilities.

Knowledge, Ability, and Commitment to Help Staff Non-Hospital Field Medical Facilities

In addition to estimating staffing resources available during a response to a WMD incident, this study sought to assess whether doctors and nurses possessed the knowledge and ability to treat victims of a WMD incident. Participants' responses concerning their WMD-related knowledge and abilities suggest a substantial need for training and education to improve Honolulu's preparedness. For instance, 71% of the nurses reported not knowing how to treat Nerve Agents, while 65% of the physicians reported the same (Table 9). In the context of international terrorism these results seem problematic, as Aum Shinrikyo, a Japanese doomsday cult, headed by Shoko Asahara, used the nerve agent sarin in the Tokyo subway system attack on March 20, 1995. This act resulted in 12 people being killed and over 1,000 sickened (17 critical patients; 37 severe, and 984 moderate). Reports from hospitals attending to patients that day stated that many nurses and doctors unknowingly were providing care for contaminated patients, and consequently became sick from secondary exposure to sarin. After the event the Japanese medical community declared that due to lack of knowledge and ability concerning sarin it was woefully unprepared for such an incident. From this experience the medical community world-wide learned that being unprepared can not only affect the quality of care given to victims of a terrorist act, but also can affect the ability of healthcare providers to give care if they themselves become contaminated or sick.[4,5] Although this information was available, based on the responses in this study, most participants did not acquire the knowledge and ability needed to respond to a terrorist incident involving the use of nerve agents such as sarin. In fact, while working with the public health and medical community through the planning and development of the Honolulu's Metropolitan Medical Response System, many in the healthcare professions voiced the opinion that a WMD event was not likely to occur in America, or, at least, not in Honolulu. The events on September 11, 2001 and the subsequent use of anthrax in the following months may have dispelled many illusions. Although, it remains to be seen through future study to what degree healthcare professionals will obtain and retain knowledge and skills in the area of WMD, it would be instructive for all those responsible for providing education and training to these professionals to determine factors specific to the medical and public health community that support or prevent acquisition of the new knowledge and skills needed.

Acquiring WMD-related knowledge and skills depends both on individual interest to do so and on environmental (or systemic) conditions acting as either supportive or preventive forces in relation to attaining knowledge and ability.[6] For instance, an overwhelming majority of participants in this study reported an interest in obtaining more training/education concerning biological or chemical agents. For the doctors, 73% wanted more biological and 72% wanted more chemical training/education, while for the nurses, 85% wanted more biological, and 84% wanted more chemical training/education. If healthcare professionals are interested in more education and training, providers of CE and administrators of hospital institutions need to determine how they can best support and strengthen this interest while providing opportunities for learning. In addition, further study should determine barriers to obtaining WMD-related training and how best to remove these barriers, so that doctors and nurses can both develop and more easily pursue their interest to learn about this area. An American College of Physicians (ACEP) report on objectives, content, and competencies for training of emergency healthcare professionals suggests that funding and time are primary barriers to developing and implementing WMD response training.[7] For example, the report lists failure of hospital administrators to recognize WMD related training as a top priority, inadequate funding to cover attendance of education and training programs (e.g., time off, tuition, and travel), and personnel shortages that make it impossible to cover positions while people are being trained as barriers to both emergency physician and nurse attendance of WMD related programs. Recent federal funding for hospital preparedness and training for healthcare professionals may help to remove these barriers and assist in the increase of knowledge and ability in the area of treatment of WMD casualties. Future studies should be conducted to determine the affect of these funding efforts on readiness of both healthcare professionals and institutions to respond appropriately to WMD incidents.

The findings in this study highlight the importance of having a knowledgeable and able medical and public health workforce to a

community's ability to provide care during a mass casualty incident. This study found that the more knowledge and ability respondents reported, the more willing they were to help staff non-hospital, field medical facilities during an incident involving a biological, contagious or chemical agent, respectively (Tables 14 to 19). This result suggests that previous knowledge and ability in WMD may be a factor related to obtaining commitment to help staff non-hospital, field medical facilities. It would seem that those who know and can do, in most cases, will do. This finding accentuates the importance of supporting WMD-related learning as an investment in the overall capacity of a community's medical and public health system, as it suggests that education and training today, will result in staff willingness to provide care during a mass casualty incident tomorrow. Consequently, medical and public health community leaders should view CE as part of a system-based development process (i.e., a learning activity responsive to systemic or organizational needs that can promote growth and development) as well as an individual-based development process (i.e., a series of learning activities responsive to the educational interests and needs of individual physicians that can lead to providing improved care).[8] Medical and public health agencies will be overrun if the magnitude of mass casualties projected for biological, chemical or radiological agent release occur. If the personnel providing care in a community are not adequately trained there easily can be a recurrence of what happened in Tokyo, as mentioned above. In contrast, in a mass casualty situation, healthcare professionals that are adequately trained will be both safe and able to provide quality care to the community they normally serve, and will have to continue to serve after the medical crisis. In this light, barriers to continuing education, whether individual-, organizational-, or systemic-based, are barriers to continuing medical effectiveness and must be addressed throughout the medical and public health community.

Furthermore, according to physician responses in this study, type of practice, i.e., Primary Care, was related to commitment to help staff non-hospital, field medical facilities (Table 20). This result suggests type of practice is a factor that should be considered when planning education and training programs. If Primary Care physicians are more likely to help staff emergency medical facilities under conditions of all types of mass casualty events, then it would seem prudent that continuing medical education planners find ways to include these community healthcare professionals in training and education programs. Especially, emergency planners should integrate Primary Care physicians in field exercises in order to better prepare them to function under emergency medical conditions and increase their knowledge and skills by working alongside emergency physicians and nurses, as well as to afford them the opportunity to apply mass casualty medical protocols. Such efforts, according to the findings in this study, might be the most efficient use of resources, and, in addition to emergency physicians, a perfect place to begin training in the medical community at large.

Differences between Knowledge and Ability

Analysis of participant responses underscored the difference between knowing and doing. For almost every biological and chemical WMD agent, both doctors and nurses responded with a similar pattern, i.e., as the questions moved from knowledge to recognition to treatment for each agent, the responses moved in the direction of fewer respondents reporting the ability to recognize and treat (Tables 1 to 12). For example, using responses to Plague as a model, 48% of the physicians reported not being knowledgeable, 52% reported not being able to recognize signs and symptoms of exposure, and 61% reported not knowing how to treat casualties of a Plague Incident. These results suggest that CME programs must not only focus on the knowledge level but must also provide activities that will allow healthcare professionals to gain practical experience in recognizing and treating these agents. The ACEP report recognizes these different levels of learning and establishes objectives for both the awareness and performance levels of emergency physician and nurse training. For example, whereas an awareness objective might be to *explain* how treatment in-place and use of alternative care facilities might be used, an objective on the performance level might be to *describe and demonstrate* initial assessment, triage, and stabilization for a biological event.[9] Consequently, it is suggested that CE programs must broaden goals to not only provide awareness and knowledge level activities but also include training and education formats that promote the use and demonstration of skills and abilities and engage the higher level cognitive processes, such as analysis, evaluation, problem solving, and decision-making, that are the essential infrastructure of quality medical care.[10,11]

Conclusion

The purpose of this study was to determine the capacity of Honolulu to provide emergency medical care to victims of an incident caused by a WMD or natural disaster and to determine the level of expertise of the healthcare professionals in the community. All doctors and nurses licensed and living in Hawaii were asked to respond to an assessment tool. The mail survey response was 25% of physicians and 22.4% of the nurses. This study provides a pre-September 11, 2001 baseline of the commitment of a population of physicians and nurses to staff non-hospital, field medical facilities during a mass casualty incident caused by weapons of mass destruction and of their knowledge and skills in relation to treatment of the victims of biological and chemical agents. The findings suggest that if Honolulu had to provide care for victims who had become symptomatic and needed inpatient treatment or critical care due to a WMD release, it would fall short of the standard established for Metropolitan Medical Response System cities set by the Department of Health and Human Services, i.e., 10% of the population (or 100,000 for Honolulu). Consequently, this study illustrates the importance of precautionary environmental surveillance and detection programs that would afford the medical and public health community the opportunity to provide prophylactic care to victims exposed to WMD, thereby eliminating or greatly reducing the need for inpatient or critical care treatment. In addition, results suggest that emergency planners can not assume that because healthcare professionals will volunteer to assist in one type of incident, e.g., natural disasters, that they are will do so under conditions involving different weapons of mass destruction, e.g., radiological, contagious epidemic, biological and chemical. Furthermore, although the methodology used in this study does not provide a statistically representative sample of the doctors and nurses in Hawaii, Honolulu and other communities might use these findings to estimate their ability to provide emergency healthcare for mass casualty incidents involving different WMD. Moreover, this study illustrates the importance of education

and training to a community's ability to respond to a WMD release, as the more knowledge and ability participants reported the more they committed to staffing emergency field medical facilities. Finally, it is suggested that emergency planners, leadership in the medical community and continuing medical education determine the level of knowledge and ability for healthcare professionals necessary to maintain readiness and preparedness in our society, support existing interest in obtaining training and education, remove barriers to utilizing CE offerings and opportunities, and then use training and educational techniques and technologies to help doctors and nurses acquire the knowledge and skills they need to be both prepared and committed to serve during a mass casualty incident resulting from the use of WMD. Future studies should determine whether there has been: 1. a change in commitment levels of healthcare professionals in relation to their willingness to volunteer during different types of WMD incidents; 2. an increase in knowledge and abilities related to WMD agents; 3. a sustained effort to support and provide appropriate CE; 4. removal of individual, organizational and systemic barriers to obtaining knowledge and skills related to WMD-relevant CE; and 5. the use and evaluation of surveillance and detection systems implemented so as to provide pre-symptomatic awareness and protection.

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